A CASE STUDY ANALYSIS OF THE
OVERHEAD RATE IMPACT MODEL
USED DURING THE C-5 MAINTENANCE
SOURCE SELECTION

THESIS

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AFIT/GAQ/ENV/01M-16

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THESIS

Presented to the Faculty

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Acquisition Management

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March 2001

AFIT/GAQ/ENV/01M-16

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## Acknowledgements

I would like to express my sincere appreciation to my faculty advisor, Lt Col Bill Stockman, for his guidance throughout the course of this thesis effort. His insight and experience were crucial to the completion of this effort. I would also like to thank all of my classmates who have made the AFIT experience more enjoyable.

A special thanks goes out to my wife and our son. Their support, encouragement, and understanding throughout this difficult process made its completion possible.

William N. Ward

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## Abstract

The Overhead Rate Impact (ORI) model was used during the C-5 Maintenance source selection to evaluate the impact the new workload would have on the existing overhead rates. The objectives of this research study were to evaluate the ORI model and to identify the lessons learned from this source selection. To accomplish these objectives, interviews were conducted with members of the source selection team who were on the Cost Integrated Product Team (IPT). The experts were asked to identify the strengths and weaknesses of the ORI model and to make recommendation on how to improve the model.

This study identified strengths and weaknesses of the ORI model. The strengths identified by the research are that the model was easy to use and the fact that the model can calculate overhead savings quickly. The weaknesses identified by the research are that the model uses an average overhead rate for the entire facility, the accuracy of the inputs is questionable, the model does not address limits to the amount of excess capacity, and that the model does not account for the theoretical limit to savings.

Based on these findings, this research makes recommendations of how overhead savings should be evaluated in future source selections. The recommendations are that overhead savings should be calculated at the lowest possible level, the amount of existing excess capacity should be evaluated, the rate and factor inputs to the model should be validated at the lowest possible level, and evaluators must recognize the theoretical limit to potential overhead savings.

# A CASE STUDY ANALYSIS OF THE OVERHEAD RATE IMPACT MODEL USED DURING THE C-5 MAINTENANCE SOURCE SELECTION

## I. Introduction

### Background

Department of Defense (DoD) acquisitions are regulated by the Federal Acquisition Regulation (FAR), which establishes the procedures by which government contracts are awarded. Part 15 of the FAR states that DoD contracts over $25,000 may be awarded using a sealed bid format or through competitive negotiations (Edwards, 1994:xi). Under the sealed bid procurement format, the only factor the government evaluates is the proposal price (Edwards, 1994:xi). Quite simply, the contract is awarded to the bidder with the lowest price. However, if the nature of the contract dictates that competitive negotiations are a more appropriate format, then the source selection team will evaluate other factors in addition to cost. Competitions that involve the evaluation and comparison of cost or price and other factors have come to be known as "best value source selections" (FAR Section 15.602). This procurement philosophy reflects DoD's recognition that it is not always wise to select contractors based on price alone (Edwards, 1994:xiii).

The FAR states that the objective of a source selection, which is the official process by which the government selects sources to perform various acquisition functions, is to select the proposal that represents the best overall value to the United States government in response to requirements (FAR, 2000). The Army Federal

Acquisition Regulation (AFAR) further defines best value acquisitions as the process used in competitive negotiated acquisition to select the most advantageous offer by evaluating and comparing factors in addition to cost or price. Best value source selections are appropriate when price or cost is not the overriding evaluation factor and the government stands to benefit from comparison of technical proposals and a reasoned tradeoff between technical and non-technical factors, including cost or price (Procurement, 1997). Best value acquisitions consider cost, price, performance, risk management, past performance, and other non-cost factors to determine the total evaluated cost of each proposal (Procurement, 1997). This assessment requires technical evaluations of the contractor's proposed supplies/services, performing risk assessments, and assessing the reasonableness/realism associated with the proposal. To achieve the requirement to evaluate more than just proposal price, proposals are broken out and evaluated based on four levels of cost: proposal price, direct costs, indirect costs, and other strengths, weaknesses, risks (Stockman, 2000).

The proposal price is simply the bottom-line price in an offeror's proposal. Direct costs are costs such as direct material and direct labor that vary proportionally with the workload. The last two categories, indirect costs and other strengths, weaknesses, and risks, recognize non-quantified factors that are benefits (or detriments) to the government but not specified in dollars. Through dollarization[1], the government attempts to quantify these additional benefits in an attempt to recognize the true overall value provided by the offeror. Examples of cost categories that have been dollarized in the past include:

[1] Dollarization is the process of assigning an estimated dollar value to a benefit or detriment that would result from the offeror's proposal for the purpose of calculating an offeror's total evaluated cost.

overhead savings, RIF[2]/PCS[3]/VERA[4]/VSIP[5] expenditures, second destination transportation, contract administration, cost of capital, transition adjustment, and USAF material costs. This research focuses specifically on the dollarization of overhead savings during a best value source selection.

**Overhead Savings**

During the proposal process, an offeror may assert that award of the contract will result in reduced overhead rates on other Government contracts currently being performed by the offeror. In this instance, the additional workload results in fixed overhead costs being spread over a larger allocation base, thereby reducing overhead rates. This reduced rate is applied to the existing government work, and the difference between the original rate and the new rate is multiplied by the original workload to calculate total overhead savings generated by the additional workload. These savings are then included in an offeror's bid as a downward adjustment.

Overhead savings can only occur when this additional government workload increases the offeror's overhead allocation base at a greater rate than it increases the offeror's overhead cost pool. In addition, the offeror must have existing excess capacity in order to absorb the increase in workload without increasing overhead costs at the same rate. If these circumstances exist, then savings result from the increased efficiency of the existing workforce and facilities.

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[2] RIF - Reduction in Force, a reduction in personnel because of various reasons
[3] PCS – Permanent Change of Station, The long-term, physical relocation of a military member and his/her family
[4] VERA – Voluntary Early Retirement Authority
[5] VSIP – Voluntary Separation Incentive Pay

Clearly, when an offeror has existing government contracts and excess capacity, it is in the best interest of the Air Force to evaluate the impact of the additional work to overhead rates. According to Baseman, "changes in a contractor's business base will have a significant impact on the costs of programs at the contractor's plant" (Baseman, 111). In the case of overhead savings, the increase in the contractor's business base decreases the overhead rates of the individual programs at the contractor's plant. The increase in the contractor's business base is a direct result of the contract being proposed; therefore, it is reasonable to take these savings into consideration when evaluating offerors' bids. Since the Air Force is receiving additional benefits of this contract award, these benefits should be recognized in a best value source selection.

**Problem Statement**

Though it is easy to see that a lower overhead rate occurs from an increased allocation base, a standard analysis tool has not been validated. The competition for the annual C-5 overhaul maintenance contract was the first source selection to include overhead savings. The public offeror, which was Warner-Robins Air Logistic Center (ALC), proposed that the new workload would result in lower overhead rates for other government programs at the facility. To evaluate these proposed savings, the Source Selection Cost IPT team used the Overhead Rate Impact (ORI) model to estimate potential overhead savings at Warner-Robins ALC (Stockman, 2000). This estimate was then used to make budget adjustments to other programs at Warner-Robins to account for the recognized overhead savings. This adjustment resulted in budget reductions for those programs that claimed shared resources with the C-5 workload. The validity and accuracy of the model is crucial since budget adjustments are made based on its output.

Additionally, private sector offerors expressed great concern over the method used to recognize overhead savings and claimed it provided an unfair advantage to public offerors (GAO, January 1998:5). In fact, one private sector offeror in the source selection characterized the overhead savings adjustments as the one factor that most favors public offerors, and stated that unless the overhead savings evaluation factors where changed, his organization would likely not compete in future public-private competitions (GAO, January 1998:8). Given this concern over the method used to calculate overhead savings and the potential budgetary impact the model results may have, a study of the ORI is prudent to address the private offerors' concerns. Accordingly, this study examines the ORI model used to calculate overhead savings during the C-5 source selection.

## Research Objectives

The goals of this research are to evaluate how well the ORI model evaluated overhead savings during the C-5 source selection and to identify the lessons learned from this source selection. These goals will be achieved by addressing four separate research objectives. The four research objectives are as follows:

1. Identify the strengths of the ORI model
2. Identify the weaknesses of the ORI model
3. Identify ways of improving the ORI model's accuracy (if any are needed)
4. Identify factors of the "ideal" method of estimating overhead savings

## Research Scope

This research effort examines the ORI model as it was used during the C-5 source selection. After gaining an understanding of the ORI model and how it was used, this

research identifies ways of improving the ORI model for future source selection teams. Based on the experiences and lessons learned from the Cost IPT members, this research provides recommendations on the most appropriate method of evaluating overhead savings during source selections.

**Research Methodology**

Data collection was conducted through a literature review and interviews. The literature review focuses on the relevancy of dollarizing overhead savings during source selections and the accounting principles associated with overhead savings. The goals of the literature review were to understand how overhead savings fits into best value source selections and the economic theories behind overhead savings. A case study analysis was conducted by interviewing members of the C-5 Source Selection Cost IPT. Since this study focuses on the experiences of this source selection, these team members are the experts regarding its use in this forum. The goal of the interviews is to document the specific strengths and weaknesses of the model as it was used for this evaluation. Furthermore, the interviews were the source of suggestions on ways to improve the model and on factors included in the ideal estimation method of overhead savings.

**Generalizability**

This research focuses on the ORI model as it was used during the C-5 source selection. The ORI model was specifically developed to analyze overhead savings for government depots. Therefore, the generalizability of this research regarding the model itself is limited to specific situations where this model is used to evaluate overhead savings. However, the theoretical aspects of improving the estimation techniques used to

evaluate overhead savings should be applicable to all circumstances where overhead savings might be calculated.

**Research Contributions**

The intent of this research is to determine if the ORI model provides source selection officials with an effective tool to estimate potential overhead savings. Overhead savings adjustments have been used in several public-private source selections, and policy has directed that these adjustments will continue to be used in future source selections. Identifying the strengths and weaknesses of the ORI model and suggesting potential improvements on the methods used to calculate these savings will aid future source selection teams that are faced with evaluating overhead savings.

**Summary**

Overhead costs are an enormous expense in government acquisition programs, and an accurate evaluation of overhead savings is essential to ensure a successful best value source selection. Policy dictates that overhead savings will be included in best value source selections; therefore, the need for an accurate and effective evaluation tool to be used in future source selections is great. This research evaluates the accuracy of the model used to estimate overhead savings during the C-5 Maintenance source selection. Based on the results of this research, recommendations will be provided for improvements to the model and for factors to include in an "ideal" model. The next chapter of this research explains in detail where overhead savings fit into best value source selections. Chapter 2 also includes an analysis of the ORI model and how it calculates overhead savings.

## II. Literature Review

### Introduction

This chapter focuses on the relevancy of overhead savings to source selection officials. It discusses how source selections have evolved from lowest price to best value. It discusses dollarization of benefits during source selections and why overhead savings should be recognized in this manner. It then discusses the model used during the C-5 Maintenance source selection and walks through how the model estimates potential overhead savings.

### Determining the Acquisition Strategy

A new program is initiated when the Defense Acquisition Board (DAB) approves the need for a new program based on an identified mission deficiency. Once the DAB gives this approval, a new program officially begins. At this point, senior officials must determine the acquisition strategy that best fits the needs of the new program. Acquisition strategy is defined as a business and technical management approach designed to achieve program objectives within the resource constraints imposed (Defense Acquisition, 1991). The acquisition strategy serves as a framework for managing the program and should reflect the needs of the program with respect to realism, risk, stability, and flexibility. The acquisition strategy chosen will play a significant role in the type of acquisition that takes place because the acquisition strategy will highlight the risks and threats associated with the program. This will be important in determining the criteria to be evaluated during the source selection. Once the program director and his staff select an acquisition strategy, it must be presented to the Acquisition Strategy Panel

(ASP) for approval. The ASP, which is comprised of senior acquisition experts, is assembled to approve or reject the proposed acquisition strategy. Upon the selection of an acquisition strategy, the ASP establishes the criteria that will be evaluated during the source selection. The criteria deemed important by the ASP will dictate the type of source selection to be used. If price is found to be the only important factor, then the source selection should be conducted using a sealed bid format. However, if the ASP recognizes other important factors besides cost, then a competitive negotiation format using a best value approach would be the most appropriate type of source selection.

**Best Value Source Selections**

As explained in Chapter 1, best value source selections evaluate all factors associated with an offerors bid. Dr. Gansler, former Under Secretary of Defense for Acquisition and Technology, noted that awarding contracts with an emphasis on low price creates enormous incentives to do anything to be the winner (Gansler, 1989). With a growing trend of programs overrunning their budgets, senior officials became concerned that focusing on price sacrificed quality, and that a low-priced, poor-quality product would eventually cost the government more money in operations and maintenance costs (Conver, 1993: 48). DoD began to recognize the fact that it may have to pay more in acquisition costs to ensure quality and potentially lower support costs (Conver, 1993:49). This paradigm shift to best value acquisitions recognizes the fact that higher quality acquisitions could prove to be cheaper over the life of the program. This new shift established the idea of recognizing the entire value of an offeror's proposal. While it may be relatively easy to recognize the dollar value of some benefits, others may not be so clear. The difficulty becomes assigning a dollar value to non-quantified

benefits so that they may be evaluated during the source selection. Notifying potential offerors that the source selection will be conducted on a best value basis is the first step in a best value source selection.

**Best Value Solicitations**

When the government issues a Request for Proposals[6] (RFP), the RFP specifies the manner in which the proposals should be prepared and how they will be evaluated (Mickaliger, 1999:43). The RFP will clearly lay out to prospective offerors if the selection will be based on lowest price or best value. If it is a best value source selection, the RFP will indicate what factors will be evaluated to calculate each offeror's total evaluated cost. In addition, the RFP will state whether all evaluation factors other than cost or price, when combined, are significantly more important than, approximately equal to, or significantly less important than cost or price (FAR, 2000: Part 15). While it is impossible and counterproductive for the RFP to identify every potential benefit that could be recognized during the evaluation process, the RFP does identify some benefits that are commonly seen, such as overhead savings. If overhead savings will be recognized during the evaluation, then this fact will be spelled out to perspective offerors in Section L. For example, the RFP for the C-5 Maintenance workload stated:

> "An adjustment shall be made to any public or private offeror's proposal price for identified and reasonable first order effect overhead costs/savings to other government workloads performed by the offeror that would be realized during contract performance."

[6] Notice to potential offerors that an evaluation committee will evaluate proposals for a specified contract

This clause in the RFP identifies to all prospective offerors that overhead savings will be evaluated as an additional benefit to the government.

Section M of the RFP establishes how the Government will evaluate the proposals, how the factors interrelate, and how many awards will be contemplated (SS Procedures, 2000). If overhead savings will be recognized, then the evaluation scheme will be provided in this section. An agency and its source selection officials should exercise particular care to ensure the evaluation of proposals is consistent with the evaluation criteria established in Section M of the RFP (Mickaliger, 1999). For example, private offerors greatly contested the manner in which overhead savings where evaluated during the C-5 Maintenance source selection. However, a legal review of the competition found that the evaluation team followed the scheme provided in the RFP and the Depot Competition Procedures handbook (GAO, January 1998:5). Since the Air Force team followed the established evaluation method, the overhead savings where found to be reasonable and eventually became the determining factor in award (GAO, January 1998:6).

**How are Overhead Savings Achieved**

If a bid is awarded to a specific offeror and the new work increases production quantity and capacity utilization, associated costs for the product decreases because of a more efficient use of existing workforce and facilities (Washington, 1997:181). The additional workload creates larger production quantities and increased economy of scale, both of which are benefits that should be quantified (Washington, 1997:173). In its review of the existing excess capacity at Air Force Depots, the GAO noted that increased economy of scale and increased efficiency decreased overhead rates on government

contracts by 18% between 1994-1997 (GAO, December 1996:7). In the late 1980's, the Base Realignment and Closure Commission (BRAC) concluded that savings result from transferring work to facilities with excess capacity (GAO, December 1996:3). Based on these findings, it is reasonable to conclude that increasing the efficiency of a specific facility results in decreases in the facility's overhead rates.

**When have Overhead Savings been Dollarized**

Dollarizing estimated overhead savings has been accomplished in several recent source selections. In the competition for the C-5 maintenance workload, the Air Force received several private sector proposals as well as one public offeror. Warner-Robins Air Logistics Center claimed the new workload would create overhead savings for other programs located at its facility. Following the cost and technical evaluations, the Air Force selected Warner Robins ALC to perform the C-5 maintenance based on the evaluation that it's proposal represented the lowest total evaluated cost to the government (GAO, January 1998:6). The expected savings were so substantial that it became a primary determining factor during the source selection (GAO, January 1998:5).

In the source selection for the Sacramento Air Logistics Center (ALC) Depot Maintenance Workload Competition, Ogden Air Logistics Center (ALC) received credit on its bid in the form of overhead savings. Since Ogden ALC had excess capacity and the additional depot maintenance workload increased it's allocation base by a greater rate than it increased Odgen's fixed costs, the ALC was able to show overhead savings would occur if it where awarded the contract. These savings were credited (subtracted) from Ogden's most probable cost estimate and reduced Ogden's overall bid by $50M (Stockman, 2000).

In the Public-Private Depot Competition for the San Antonio Engine Depot Maintenance Workload, source selection officials credited Oklahoma City Air Logistics Center with a downward adjustment to its bid price to account for overhead savings. The additional workload could be added to Oklahoma City's existing workload and result in decreases to the existing overhead rates. While these savings did not play a crucial role in the outcome of the source selection, they did reduce OKC's bid price by $200M (Stockman, 2000).

In addition to the examples of overhead savings inclusion during recent source selections, Air Force officials have received the following policy guidance regarding the evaluation of overhead savings. A 20 December 1997 letter from SAF AQ/FM states:

> "An adjustment shall be made to each public or private contract proposal price for identified and reasonable overhead costs/savings to other government workloads performed by the offeror that would be realized during contract performance. The overhead adjustment costs/savings shall be computed by subtracting the new overhead rates from the old overhead rate and multiplying the difference by the existing (excluding workload under competition) government workload overhead base. "

The policy further states that:

> " An adjustment shall be made to any public or private offeror's contract proposal price for any other costs or benefits to the government that would be incurred/accrued if awarded the contract."

The evaluation of overhead savings is an additional benefit that should be dollarized during a best value source selection. If the acquisition strategy dictates a best

value source selection, then recognizing overhead savings is reasonable. Based on precedent and policy, this is an evaluation that belongs in a best value source selection. Having established the need to evaluate overhead savings during best value source selection, this research will now focus on the manner in which these savings are calculated.

## Overhead Costs

In Department of Defense (DoD) acquisitions, overhead costs have an enormous impact on the cost of military programs. Given the magnitude of typical military acquisition programs, overhead charges can cost the government hundreds of millions of dollars. In 1995, the DoD estimated that overhead costs average about one-third of a contract's price (GAO, May 1995:3). In addition, senior DoD acquisition officials have expressed concern that the decline in defense spending will lead to increases in contractor's overhead rates (GAO, May 1995:2). As the military purchases lessen due to declining budgets, defense contractors' business bases will decrease. This decrease results in contractors' fixed costs being spread over a smaller allocation base causing an increase in overhead rates. This concern supports the contention that an organization's business base is a direct determinant of the amount of overhead any one given program will bear (Baseman 111).

## Overhead Rate Calculations

Overhead costs are expenses that exist for the common good of the organization and that cannot be reasonably or cost-effectively charged directly to a specific activity or product (Fultz, 1980:9). They typically include all product costs other than direct material and direct labor that result from operations but cannot be directly attributed to a

specific product. These costs are generally considered fixed costs since they do not vary based on the level of production or activity. Some examples of overhead costs are indirect material, indirect labor, insurance, utilities, rent, and depreciation. Overhead costs are costs associated with doing business, and all products share benefits associated with these costs. Since all products receive benefits from these costs, they cannot and should not be assigned to just a few products. For this reason, they are added together to form a "cost pool" known as overhead. These costs are then distributed to products using some rational and logical allocation base that is common to all products within an organization, such as by direct labor hours or direct machine hours (Garrison & Noreen, 1994:77).

Overhead rates are calculated by dividing the overhead pool by the specified allocation base, as shown below:

$$\frac{\text{Estimated Annual Overhead Costs}}{\text{Estimated units of the Allocation Base}}$$

So, if an organization has estimated overhead costs for the year to be \$100,000 and has estimated 10,000 direct labor hours for the year.

$$\frac{\$100{,}000}{10{,}000} = \$10 \text{ per labor hour}$$

This results in an overhead rate of \$10 per labor hour.

Since these rates are predetermined and computed using estimated data, any changes in the overhead cost pool or the allocation base will affect the overhead rates (Garrison & Noreen, 1994, p. 77). For example, if the organization above acquires

additional work that will increase it's annual labor hours by 10,000 without increasing the overhead cost pool, then the overhead rate will drop to $5 per labor hour.

$$\frac{\$100{,}000}{20{,}000} = \$5 \text{ per labor hour}$$

As a direct result of the increase in labor hours, each product will only be assessed $5 per labor hour in overhead costs as opposed to $10 per labor hour. Since existing programs realize a $5 per labor hour decrease in overhead costs, first order savings occur from the additional workload. The difference between these two overhead rates ($5 per labor hour) represents the overhead savings that result from the additional 10,000 labor hours.

Garrison and Noreen also noted that large organizations often have multiple predetermined overhead rates, usually one for each department (1994:94). This is due to the fact that each department's costs may be driven by different activities. One single plant-wide overhead rate equitably allocates overhead costs if costs are incurred at the same rate throughout the plant; however, if more than one rate exists in the facility, then a single plant-wide rate does not equitably allocate overhead rates (Garrison & Noreen, 1994:94). Therefore, overhead rates need to be calculated and evaluated at each level where different rates exists. This also indicates that overhead savings should be calculated and evaluated at the lowest possible levels.

**ORI Model**

The Overhead Rate Impact (ORI) Model was developed by analysts at several Air Logistics Centers (ALC) to analyze and predict the impact of additional workloads to overhead rates at the ALCs. The model estimates the potential overhead savings that result from the additional work by analyzing the portion of the new work that involves

fixed costs. Since variable costs (direct labor and direct material) increase and decrease in direct proportion to the amount of work that is performed at the facility, they are not potential sources of savings. The fixed costs associated with the new workload are the only potential sources of savings.

The model estimates the percentages of new work that are fixed costs and variable costs. The fixed cost percentage is then multiplied by the new workload cost, and the product is added to the existing total of fixed costs. That total (existing fixed costs + new workload fixed costs) is then divided by the total number of hours (existing hours + new hours) to calculate the new overhead rate. If fixed costs increase at a lesser rate than the allocation base, then this overhead rate will be lower than the original overhead rate. The new overhead rate is then subtracted from the old overhead rate, and that difference is multiplied by the existing hours to come up with the estimated overhead savings.

The ORI analyzes all costs associated with the new workload and their impact on the overhead rates at the facility. Direct costs are included in the model, but since direct costs (labor and material) are variable costs that do not impact overhead rates, these costs are not evaluated as sources of savings. Production Overhead costs and General & Administration costs are analyzed in the spreadsheet as potential sources of savings. The model divides production overhead into two categories: indirect costs and shop support costs. These two categories are summed up to create the entire production overhead pool. The model calculates savings by multiplying the existing overhead rate for each Work Breakdown Structure (WBS) activity by a % variability factor. The % variability factors are provided by the offeror based on the input of experts working in the respective WBS activities. The model uses the % variability factor and the existing rate to calculate the

impact of the new workload. The following section walks through an example of the ORI model.

Though the ORI model was developed specifically to predict the overhead impact of additional work, it has been used in another situation. In the previously mentioned 1996 GAO report, the GAO used the model to estimate the amount of excess capacity at the existing public depots. During the C-5 source selection, the model was suggested as a manner in which overhead savings could be evaluated. Since the model has been used in these other instances, it is appropriate to note that this research is looking specifically at how the model was used during this source selection.

**Example of ORI Model**

The following is an example spreadsheet of the ORI model. This section walks through each of the calculations on the spreadsheet. This explanation of how the model works is necessary for the reader to follow the critique of the model in the following chapters. The numbers shown in the model are not the actual numbers evaluated during the source selection.

## Table 2-1. Overhead Rate Impact Model

| | |
|---|---|
| FY98 DPAH | 6,000,000.0 |
| Proposed Additional Work | 1,000,000.0 |
| Total FY98 Workload (+ New) | 7,000,000.0 |

| ACTIVITY | FY98 Costs | FY98 Rate | Rate Impact Calculations<br>% Variable Similar Work | Rate For Similar Work | Added Hours to Existing Workload | Costs to | Totals |
|---|---|---|---|---|---|---|---|
| **DIRECT** | | | | | | | |
| *Total Direct* | $ 167,250,000 | $27.88 | 100.00% | $27.88 | 1,000,000 | $27,875,000 | $195,125,000 |
| **PRODUCTION OVERHEAD** | | | | | | | |
| **INDIRECT** | | | | | | | |
| Indirect Civilian Labor | $ 26,778,000 | $4.46 | 70.00% | $3.12 | 1,000,000 | $ 3,124,100 | $ 29,902,100 |
| Indirect Military Labor | $ 72,000 | $0.01 | 0.00% | $0.00 | 1,000,000 | $ - | $ 72,000 |
| Ind Material U6100 | $ 12,360,000 | $2.06 | 100.00% | $2.06 | 1,000,000 | $ 2,060,000 | $ 14,420,000 |
| Ind Material U6300 | $ 2,970,000 | $0.50 | 0.00% | $0.00 | 1,000,000 | $ - | $ 2,970,000 |
| Engine Fuel U6511 | $ - | $0.00 | 100.00% | $0.00 | 1,000,000 | $ - | $ - |
| Equip U66/80 | $ 1,080,000 | $0.18 | 100.00% | $0.18 | 1,000,000 | $ 180,000 | $ 1,260,000 |
| Indirect Other Expense | $ 5,586,000 | $0.93 | 79.00% | $0.74 | 1,000,000 | $ 735,490 | $ 6,321,490 |
| *Total Indirect* | $ 48,846,000 | $8.14 | | $6.10 | 1,000,000 | $ 6,099,590 | $ 54,945,590 |
| | | | | | | | $ - |
| **SHOP SUPPORT** | | | | | | | $ - |
| *Total Shop Support* | $ 156,018,000 | $26.00 | | $7.56 | 1,000,000 | $ 7,560,800 | $163,578,800 |
| | | | | | | | $ - |
| ***Total Production Overhead*** | $ 204,864,000 | $34.14 | | $13.66 | 1,000,000 | $13,660,390 | $218,524,390 |
| | | | | | | | $ - |
| **G & A Costs** | | | | | | | $ - |
| ***Total G& A*** | $ 31,842,000 | $5.31 | | $0.14 | | $ 140,250 | $ 31,982,250 |
| | | | | | | | $ - |
| **TOTAL Costs** | $ 403,956,000 | $67.33 | | | | $41,675,640 | $445,631,640 |

| | Costs | Hours | Wrap Rate | Direct | Prod O/H | G&A |
|---|---|---|---|---|---|---|
| **Total FY 98 W/O New Workload** | $ 403,956,000 | 6,000,000 | $67.33 | $ 27.88 | $ 34.14 | $ 5.31 |
| **Total FY 98 With New Workload** | $ 445,631,640 | 7,000,000 | $63.66 | $ 27.88 | $ 31.22 | $ 4.57 |

| | |
|---|---|
| O/H hourly rate without C-5 | $ 39.45 |
| O/H hourly rate with C-5 | $ 35.79 |
| O/H hourly rate savings | $ 3.66 |

The top-left corner of the spreadsheet shows the amount of work that is presently being conducted at the facility. In this example, there are 6,000,000 Direct Production Actual Hours (DPAH) for FY98. The additional workload being proposed is also listed in the top-left corner. The "Activity" column identifies the specific Work Breakdown Structure (WBS) activities involved. The column titled "FY98 Costs" lists the existing cost for each WBS activity. In this example, the actual FY98 cost for Indirect Civilian Labor was $26,778,000M. The "FY98 Rate" column represents the existing rates for each WBS activity. These rates are the actual rates for FY98, which are calculated by dividing the WBS costs by the existing workload. So, the existing rate for Indirect Civilian Labor is $4.46/hr ($26,778,000M/6,000,000).

The column titled "% Variable Similar Work" is one of the most important inputs of this model. This column represents the percentage of costs for each WBS that varies with additional work. So, since Indirect Civilian Labor varies 70% with changes to the workload, the percentage in this column is 70%. This means that each additional unit of work for indirect civilian labor is 70% variable costs and 30% fixed costs. The next column shows the new rate, which is calculated by multiplying the existing rate by the variability factor. So, the new workload for Indirect Civilian Labor will be charged at a rate of $3.12/hr ($4.46 * 70%). This means that Indirect Civilian Labor has excess capacity such that it may absorb the new workload without incurring any additional fixed costs. Conversely, Indirect Military Labor does not vary with changes to the workload, so the variability factor is shown as 0%. This indicates that the workload could be absorbed without incurring additional fixed costs associated with Indirect Military Labor. In a third example, the variability factor for Indirect Material is 100%, which means costs

for this WBS vary directly with the increase in workload. There is no change in the overhead rate for this WBS, so the new workload will be charged at a rate of $2.06/hr. As illustrated in the example of Indirect Civilian Labor, any WBS with costs that are less than 100% variable is a potential source of overhead savings.

The "Added Hours to Existing Workload" is simply the additional workload that is being proposed. In this example, the proposal is for 1,000,000 labor hours. The "Costs to" column lists the costs of the new workload. This is calculated by multiplying the new rate by the additional workload. Indirect Civilian Labor's cost for the new workload is $3,120,000M ($3.12 * 1,000,000 Hrs). Finally, the "Totals" column is the sum of the cost of the existing workload costs and the additional workload costs. Indirect Civilian Labor has a total cost of $29,902,100M ($26,778,000 + 3,124,100). Having calculated the impact of the additional workload, the overhead rates are then calculated.

The row titled "Total Production Overhead" sums up the totals from Shop Support and Indirect Costs. In the column titled "FY98 Costs", the total production overhead costs are found to be $204,864,000M (156,018,000 + 48,846,000). Total Production Overhead costs are divided by existing hours at the bottom of the spreadsheet to calculate the existing production overhead rate as $34.14 ($204,864,000/6,000,000). The total production overhead rate is then added to the G & A rate to calculate the total overhead rate. This rate is found to be $39.45/hr ($5.31 + $34.14). This is the average existing overhead rate for the facility without the new workload. Now we must calculate the overhead rate including the new workload. On the row titled "Total Production Overhead" and the column titled "Totals, the spreadsheet shows the production overhead costs of the existing workload plus the overhead costs of the new workload. This cost is

shown as $218,524,390. The new production overhead rate is shown at the bottom as $31.22/hr ($218,524,390/7,000,000).

The new G & A rate, which is calculated using the same factor analysis, is shown to be $4.57/hr. These two rates are summed together to come up with the new overhead rate of $35.79/hr. Finally, the difference between these two overhead rates represents the overhead savings that result from the new workload. The bottom line of the spreadsheet shows that the overhead rate decreases $3.66/hr ($39.45- $35.79) as a result of the additional workload. The overall savings would be this new rate times the existing workload, which results in overhead savings of $21,960,000 ($3.66 * 6,000,000).

**ORI Model Assumptions**

The previous example walked through the ORI Model and how it calculates overhead savings. This model is based on several key assumptions. The first of these assumptions is that one average overhead rate can be used to calculate the savings. The bottom-line number provided by the model is an average rate for the entire facility in question. The model assumes that this single rate adequately reflects the overall overhead rate for the facility. Secondly, the model assumes that the cost and rate information provided by the offeror is accurate. The accuracy of these inputs is critical to the validity of the output. Additionally, these rates and costs should be traced back to those in the offeror's bid. The ORI model also assumes that each WBS activity that is not 100% variable will be able to take on the additional workload without incurring additional fixed costs. Finally, the accuracy of the % variability factor is critical to the output of the model. Additionally, the offeror must provide cost, rate, and variability data in order for the source selection team to use the ORI model.

## Summary

Best value source selections evaluate all relevant factors associated with an offeror's proposal. If an offeror has an existing facility with excess capacity, then this a benefit that should be quantified. The C-5 maintenance competition was the first source selection to recognize these savings as a benefit. The source selection team used the Overhead Rate Impact model to evaluate the savings during the evaluation period. Because of these factors, this research focuses on the effectiveness of the model used during this source selection. The next chapter will outline the methodology used to gather the data to evaluate the ORI model.

# III. Methodology

## Introduction

The chapter describes the methodology used to answer the research questions posed in Chapter 1 of this research. The discussion includes the methodology used to analyze the ORI model, the rationale behind the data collection method chosen, the development of the interview questions, how experts were identified and selected, and how the data will be used to evaluate the ORI model.

## Methodology

The selection of a research methodology is one of the most important steps in beginning a research effort. The design of a research effort constitutes a blueprint for collecting, measuring, and analyzing data (Cooper and Schindler, 1998:130). There are five major research designs in the social sciences: experiments, surveys, archival analysis, histories, and case studies (Yin, 1994:4). Yin proposed a set of conditions to guide researchers in choosing the most advantageous strategy for their particular research questions (Yin, 1994:4). The three conditions are:

(1) the type of research posed;

(2) the extent of control an investigator has over actual behavioral events;

(3) the degree of focus on contemporary as opposed to historical events.

Based on these three conditions, Yin developed the system represented in Figure 3-1 to guide researchers in selecting the most appropriate research methodology.

| Strategy | Form of Research Question | Requires Control Over Behavioral Events? | Focuses on Contemporary Events |
|---|---|---|---|
| Experiment | how, why | yes | yes |
| Survey | who, what, where, how many, how much | no | yes |
| Archival Analysis | who, what, where, how many, how much | no | yes/no |
| History | how, why | no | no |
| Case Study | how, why | no | yes |

**Figure 3-1. Relevant Situations for Different Research Strategies (Yin, 1994:6)**

The first condition attempts to simplify the proposed research questions into "who", "what", "where", "how", and "why" categories (Yin, 1994:5). In Chapter 1, the research question of this effort was stated as: Is the ORI model an effective tool for evaluating overhead savings during source selection? This research question falls into the "how" category of Yin's system since the question can be restated as: How effective is the ORI model at evaluating overhead savings during source selections? Yin notes that "how" questions are more exploratory in nature and often favor case studies, history, and experiments (1994:6). The second condition deals with the amount of control the researcher has over the events being researched. This research is looking at the specific model used during the completed C-5 source selection, so this researcher had no control of the behavioral events being studied. The final condition looks at the focus of the research to aid in the selection of a research design. As noted in the previous two chapters, evaluating overhead savings is a relatively new practice that has come under a great deal of scrutiny. As such, it could be classified as a contemporary issue. Based on

Yin's system for selecting a research design, the case study methodology is the most appropriate manner in which to evaluate the ORI model.

## Case Study Design

Once the case study methodology was chosen, the next step involved determining the type of case study design to be used. Yin further outlined case study designs by providing a methodology to aid the researcher in selecting the most appropriate case study design. Figure 3-2 shows the type of case study analysis to be used given the specifics of the research effort.

| | Single-Case Design | Multiple-Case Design |
|---|---|---|
| Holistic (single unit of analysis) | Type 1 | Type 3 |
| Embedded (multiple unit of analysis) | Type 2 | Type 4 |

**Figure 3-2. Basic Types of Designs for Case Studies (Yin, 1994:39)**

As noted in earlier chapters, the ORI model was selected for study because it was the first source selection in which overhead savings were evaluated. Source selections following the C-5 competition did not use the ORI model, so this is the only case where this model has been used for evaluation purposes during a source selection. Because of this, the research design is a single-case design. Since this effort is only looking at single unit of analysis (the ORI model), the research design chosen is a Type 1 holistic, single-case study.

## Data Collection

Interviews were chosen as the most appropriate data collection methodology for this research. This research sought to draw out expert opinion regarding the applicability and accuracy of the ORI model based on their experience. The only two data collection methods suitable to gather this information were questionnaires and interviews, and a questionnaire was deemed too structured because it would not provide the specific insight that this research was seeking. Glastonbury and MacKean note that often times there is little alternative to interviewing because of the nature of the data sought by the researcher (1991:227). The interaction between the interviewer and the interviewee provides an opportunity for the researcher to seek further clarification or explanation regarding answers. The ability to allow the experts to elaborate on their opinions, make specific points, provide additional insight, and make any suggestions they saw fit was necessary because that was the specific information this research sought. These factors led me to choose interviews as the appropriate data collection method.

All interviews were conducted in accordance with AFI 36-2601, Personnel: Air Force Personnel Survey Program and local Air Force Institute of Technology (AFIT) procedures. Participants were reminded that their identities would not be disclosed and that their responses would not be incorporated into this research in such a way that allows tracking back to the source. The pool of potential interviewees consisted of those personnel who participated in the C-5 source selection. This limited the number of potential subjects who could be interviewed. Though this research is dealing with a relatively small sample, the experience of using the model is the exact knowledge that these interviews sought to extract. The small sample is a reality of dealing with a new,

previously un-researched topic. Because this research is exploring the opinions of the users and is a case study, it is not believed that sample size is a threat to the validity of this research.

**Interviews**

The purpose of these interviews was to gather expert opinions on the accuracy and validity of the model. The interview questions are listed below. The interview questions are very simple and straightforward. The questions are explicate enough to ensure the interviewee understands what he or she is being asked while allowing plenty of flexibility for the experts to answer the question as they see fit. The open-ended nature of the questions is common in case study interviews because it allows the respondent to provide their opinion as well as the facts about the specific case (Yin,1994:84).

The first two questions were asked to ensure the interviewee has experience working with the ORI model. The rest of the questions are directly linked to the research objectives they support.

The experts were identified as members of the C-5 Source Selection Cost IPT. These were the actual people who worked with the ORI during the source selection, so they had far more insight than anyone regarding the effectiveness of the model. Of the 10 potential experts, 6 were contacted and interviewed for this research.

**Interview Questions**

1. Are you familiar with the concept of overhead savings?

2. Have you used the ORI model to calculate overhead savings in past or present source selections?

3. What do you feel are the strengths of this model?

4. What do you feel are the weaknesses of this model?

5. How would you suggest improving on this model?

6. What would be the most accurate way of calculating overhead savings?

**Evaluation of model**

Once the interviews were completed, I used the results to evaluate the accuracy and effectiveness of the ORI model in calculating overhead savings. The interview results provided a basis to establish the strengths and weaknesses of the model. The interview results also provided a foundation to recommend improvements to the ORI model and theoretical ideas of how to ideally estimate overhead savings.

**Limitations of Methodology**

Though a case study analysis was deemed the most appropriate methodology for this research, there are some limitations that should be addressed. The first limitation is the experts from whom the data was collected. The C-5 Source Selection was conducted in 1996, and the data collection for this research was collected in December 2000 and January 2001. This forced the experts to draw on events and experiences that happened over four years ago. Additionally, the experts only used the model for this one source selection, so familiarity with the model was limited to this specific experience. Although these limitations exist, they are the result of analyzing a specific case study. The experts identified are such because they used the model for the specific purpose of estimating overhead savings. Their experiences in this case are exactly what this research sought to capture. Finally, as noted in chapter 2, the GAO has used this model in evaluating the excess capacity at public depots. Including members of the GAO and analysts that were

involved in the development of the model as potential experts could have added to the external validity of this research. Though others could have provided insight into the functioning of the model, their usefulness for this research was insignificant since they had no experience with using the model to estimate overhead savings.

## Summary

This research used an open-ended interview technique to extract expert opinions regarding the ORI model. Interviews were used to gather expert opinions regarding the strengths and weaknesses of the ORI model. The experts also provided insight on how to improve the ORI model and how to ideally estimate overhead savings. Though there are some limitations to the methodology used, it was appropriate given the research objectives. The following chapter presents the results of the interviews and the analysis of the ORI model based on these results.

## IV. Findings and Analysis

### Introduction

This chapter contains the research findings and analysis resulting from the interview process. The results of the interviews are presented beneath the research objective that the interview question supports. The chapter concludes with a theoretical recommendation of how to evaluate overhead savings.

### Research Objective 1

*Identify the strengths of the Overhead Rate Impact (ORI) model*

Each of the experts was asked to identify the strengths of the Overhead Rate Impact model. This question was important for this research because it helped identify positive aspects of the model. It also recognized aspects that should be included in the "ideal method".

All six of the experts interviewed identified the fact that the model is straightforward and easy to use as its primary strength. Once the data is provided for the model, it is simple to input the relevant information, and the model then calculates the savings. One expert identified another strength of the model to be that it forces the source selection team to consider the impact of adding or deleting work from an existing facility. This expert felt that even if the information provided by the model was not entirely accurate, the model provides a rough estimate of the impact of additional work to the facility. The fact that the model forces this consideration is a strength in itself. Additionally, this expert noted that the biggest obstacles most source selection teams face is time constraints. Given this constraint, this model provides the team with a tool to quickly gain an overall idea of the magnitude of savings the new workload will generate.

## Research Objective 2

*Identify the weaknesses of the Overhead Rate Impact (ORI) model*

The experts were asked their opinions of the weaknesses of the ORI model. It was necessary to identify the weaknesses of the model in order to identify areas where accuracy and applicability could be improved.

All of the experts identified the primary weakness of the ORI model being that the model assumed one overhead rate for the entire base. The bottom line of the model provides an estimated overhead rate based on the existing workload and the proposed workload. This overhead rate results from adding all of the production overhead costs for the entire base and then dividing that cost by the total existing hours on the base before and after the additional workload.

This averaging technique is inadequate for several reasons. First of all, the averaging technique includes programs that have no shared resources with the C-5 maintenance workload. This means some programs received credit for overhead savings even though the addition of the C-5 would not have an impact on the program. The following example will help to explain this issue further:

**Table 4-1. ORI Model at Aggregate Level**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FY98 DPAH | 6,000,000.0 | | | | | | |
| Proposed Additional Work | 1,000,000.0 | | | | | | |
| Total FY98 Workload | 7,000,000.0 | | | | | | |
| | | | Rate Impact Calculations | | | | |
| | | | | | Added | | |
| | | FY98 | % Variable | Rate | Hours to | | |
| Production Overhead | FY98 Costs | Rate | Similar Wkld | Similar Wkld | Similar Workload | Costs to | Totals |
| Indirect | | | | | | | |
| Indirect Civilian Labor | $ 26,778,000 | $4.46 | 70.00% | $3.12 | 1,000,000 | $ 3,124,100 | $ 29,902,100 |

Table 4-1 shows the WBS activity of Indirect Civilian Labor. This is the only WBS activity shown to simplify the illustration of this point. The calculations for the FY98 Costs, the FY98 DPAH, and the FY98 Rates are all calculated at the base level. Indirect Civilian Labor is shown to be 70% variable, so the impact of the new workload decreases the overhead rate for this WBS from $4.46/hr for FY 98 to $4.27/hr ($29,902,100/7,000,000). This would result in overhead savings of $1,140,000 ($4.46-$4.27 * 6,000,000). However, since these calculations are done at the aggregate level, this new rate does not take into account whether or not the programs have shared resources with the C-5 workload. The effect of this is that programs that are not impacted by the C-5 workload will have an artificially low overhead rate, and programs that are impacted by the C-5 workload will have an artificially high overhead rate.

The problem above can be demonstrated by challenging the assumptions of Table 4-1. Assume there are three programs base that make up the aggregate total shown in Table 4-1. The ORI model shows 6,000,000 DPAH as the existing aggregate workload, so assume the hours are distributed as follows: Program A has 3,000,000 DPAH, Program B has 2,000,000 DPAH, and Program C has 1,000,000 DPAH. Program A has no shared resources with the C-5 workload, while Programs B and C share resources equally with the C-5. The ORI model in Figure 4-1 decreases the overhead rate for indirect civilian labor from $4.46 to $4.27 for Program A even though Program A will not get any benefit from the C-5 workload. Table 4-2 shows the real impact of the new workload when the rates are calculated for each individual program.

Rate Impact Calculations

| PROGRAM A | FY98 Costs | FY98 Rate | % Variable Similar Wkld | Rate Similar Wkld | Added Hours to Similar Workload | Costs to | Totals | New Rate |
|---|---|---|---|---|---|---|---|---|
| PRODUCTION OVERHEAD | | | | | | | | |
| INDIRECT | | | | | | | | |
| Indirect Civilian Labor | $13,389,000 | $4.46 | 70.00% | $3.12 | 0 | $0 | $13,389,000 | $4.46 |
| FY98 DPAH | 3,000,000 | | | | | | | |

| PROGRAM B | FY98 Costs | FY98 Rate | % Variable Similar Wkld | Rate Similar Wkld | Added Hours to Similar Workload | Costs to | Totals | |
|---|---|---|---|---|---|---|---|---|
| PRODUCTION OVERHEAD | | | | | | | | |
| INDIRECT | | | | | | | | |
| Indirect Civilian Labor | $8,926,000 | $4.46 | 70.00% | $3.12 | 500,000 | $1,562,050 | $10,488,050 | $4.20 |
| FY98 DPAH | 2,000,000 | | | | | | | |

| PROGRAM C | FY98 Costs | FY98 Rate | % Variable Similar Wkld | Rate Similar Wkld | Added Hours to Similar Workload | Costs to | Totals | |
|---|---|---|---|---|---|---|---|---|
| PRODUCTION OVERHEAD | | | | | | | | |
| INDIRECT | | | | | | | | |
| Indirect Civilian Labor | $4,463,000 | $4.46 | 70.00% | $3.12 | 500,000 | $1,562,050 | $6,025,050 | 4.02 |
| FY98 DPAH | 1,000,000 | | | | | | | |

**Table 4-2. Overhead Analysis for Individual Programs**

Program A has no shared resources with the C-5 workload, so the overhead rate for Program A remains at $4.46/hr (13,389,000/3,000,000). Program B shares some resources with the C-5, so the overhead rate for Program B drops from $4.46/hr to $4.20/hr (10,488,050/2,500,000). Program C also shares resources with the C-5, so the overhead rate for Program C drops from $4.46/hr to $4.02/hr (6,025,050/2,500,000). Table 4-2 shows exactly how each of the programs is impacted by the C-5 workload, so now lets see the difference in savings that result from these different calculations.

Tables 4-3 and 4-4 summarize the differences in calculating the savings at the

| PROGRAM | Existing OH rate | New OH Rate | Savings per DPAH | Total Savings |
|---|---|---|---|---|
| A (3,000,000 DPAH) | $4.46 | $4.27 | $0.19 | $570,000 |
| B (2,000,000 DPAH) | $4.46 | $4.27 | $0.19 | $380,000 |
| C (1,000,000 DPAH) | $4.46 | $4.27 | $0.19 | $190,000 |

**Table 4-3. Rate Impact Using The Aggregate Rates**

aggregate level and at the program level. Table 4-3 shows a decreased rate for Indirect Civilian Labor for each program as $4.27/hr. So, using the average rate for the entire base, the model calculates savings for this WBS as shown below.

| Program | Existing OH rate | New OH Rate | Savings per DPAH | Total Savings |
|---|---|---|---|---|
| A (3,000,000 DPAH) | $4.46 | $4.46 | $0 | $0 |
| B (2,000,000 DPAH) | $4.46 | $4.20 | $0.26 | $520,000 |
| C (1,000,000 DPAH) | $4.46 | $4.02 | $0.44 | $440,000 |

**Table 4-4. Rate Impact When Calculated at Program Level**

However, Table 4-4 illustrates the real impact to the existing overhead rates due to the increased workload. Since Program A does not have any shared resources with the C-5, the program does not realize any savings. But Programs B and C do share resources, and their actual rates are lower than predicted by the averaging technique.

So, by using the average rates as the ORI model does, some programs receive credit for overhead savings when they shouldn't, and some programs do not receive enough credit for the savings that will actually occur. Furthermore, the total amount of savings recognized by this single WBS is lower when the calculations are done at the program level.

All of experts also identified the potential error in inputs as the next major weaknesses of the ORI model. To begin, the percent variability factor was simply provided by expert opinion. The offeror could not validate these factors with data, and no grassroots estimate or bottom-ups build-up was ever conducted to determine the accuracy of these factors. The experts felt that this potentially introduced error and/or bias. Since these factors are one of the most important inputs of the model, it is reasonable to expect data to support the factors provided. Another issue related to the averaging technique used by the ORI model is that it assumes all indirect costs pools are the same.

Another weakness identified by 4 of the 6 experts is that the model does not address how much excess capacity exists for each WBS activity and the applicable range for the overhead rates. The model allows activities to absorb an unlimited amount of workload if the percent variability factor is less than 100%. This practice assumes that each of the activities has enough excess capacity to absorb that amount of workload.

While some activities may be able to absorb the entire new workload and realize overhead savings, it is not necessarily true for all activities. This application assumes that the existing costs are linear or applicable for an unlimited amount of work. The experts recognized that this was not necessarily the case. For example, lets assume a WBS activity has 100,000 hours of existing work and is operating at 70% capacity. A proposal is submitted for another 100,000 hours of work, and the WBS activity is given a percent variability factor of 50%. Since the WBS activity has a percent variability factor less than 100%, it would be a potential source of savings in the ORI model. The model would allow savings to be credited for the entire 100,000 hours; however, savings would not result over the entire range because the activity does not have the capacity to absorb all the new work. From a theoretical standpoint, since the WBS activity is operating at 70% capacity, the most amount of work it could absorb is about 43,000 hours (100,000/.7). At that point, the WBS activity would be operating at 100% capacity. At that point, the WBS activity would have to incur more fixed costs, such as faculties or machinery, to accomplish the work. When additional fixed costs are incurred, the overhead savings calculations provided by the ORI are no longer applicable. The overhead rates would change as a result of the additional fixed costs, so the rates in the ORI model would not be valid for the workload that exceeded 100% capacity for the WBS. The costs in the model are assumed to be linear over an unlimited range, when in reality they are incurred in a step-function fashion.

Another weaknesses of the ORI model identified by 5 of the 6 experts is that the overhead rates provided in the model where not associated with the overhead rates in the offeror's bid. As mentioned earlier, the overhead rates where calculated based on the

workload of the entire depot. Therefore, the overhead rates calculated in the ORI model where not the true rates associated with the C-5 workload. In fact, since the rates in the ORI model were calculated based on averages, these rates could not be identified in any program on the base. Without a connection between the rates in the model and the rates in the bid, the source selection team had difficulty determining how the calculated savings would actually impact the offeror's bid.

The research also indicated that the ORI model does not address the theoretical limit to the amount of savings that an organization can achieve. This limit is the difference between the full amount of overhead in the proposal and the marginal cost of the additional workload. This difference is the excess contribution the new program pays to the overhead pool, and the savings cannot be more than this excess contribution because it would violate the prohibition against marginal costing. The following example will help illustrate this point. A proposal submitted by an offeror includes a specific amount of overhead. In the case of the C-5, the amount of overhead in the offeror's proposal for FY1998 was approximately $33M. Now, the marginal costs associated with the additional workload are calculated in the ORI model. Table 4-5 shows the total production overhead costs from the ORI model to be $13,660,390M, which is the actual cost associated with adding the C-5 workload to the current facility.

| Rate Impact Calculations | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Production | FY98 Costs | FY98 Rate | % Variable Similar Wkld | Rate Similar Wkld | Added Hours to Similar Workload | Costs to | Totals |
| Overhead | $ 204,864,000 | $34.14 | | $13.66 | 1,000,000 | $13,660,390 | $218,524,390 |

**Table 4-5. Excess Contribution to Overhead Pool**

So, the excess overhead contribution by the C-5 program for this year would be $19.34M ($33M – 13.66M). The C-5 paid $33M to the overhead pool but only incurred $13.66M

in overhead costs. The excess contribution of $19.34M is the maximum amount of savings that can be achieved for this specific year. However, the ORI model calculated overhead savings at $21,960,000 ($3.66 * 6,000,000). The ORI model should recognize that there is a limit to the amount of overhead savings that can be achieved.

**Research Objective 3**

*Identify areas were the Overhead Rate Impact (ORI) model could be improved*

The experts were asked to identify specific areas of the ORI model that, in their opinion, could be improved to enhance the accuracy of the ORI model. It was necessary to identify these areas in order to help this research arrive at the theoretical "ideal way" to estimate overhead savings. As expected, the suggestions for improving the ORI model are closely linked to the weaknesses identified by the experts.

All of the experts stated that the evaluation of overhead rates and the impact new workloads would have on these overhead rates should be conducted at the lowest level possible. Their suggestion was to analyze every Responsibility Cost Center (RCC) that would potentially share resources with the new workload. The RCC is the "shop level" and is the lowest level where costs are tracked in the Air Force. Rates would then be calculated for each specific RCC, which would greatly improve the reliability and accuracy of the overhead savings estimates.

Each of the experts also commented that the validity of the percent variability factors must be validated to a greater extent. By conducting analysis at the RCC level, the source selection team would be able to confirm these factors through data analysis and discussions with the RCC managers. One expert commented that a regression analysis of how new workloads have impacted overhead rates in the past would be

helpful to gain an understanding of how the facility captured the proposed savings. This expert noted that the regression analysis in itself should not be used to estimate overhead rates because the estimates would be outside of the regression's applicable range, but that the regression would be useful to gain an understanding of the RCCs ability to achieve savings.

Four of the experts agreed that the rates provided by the ORI model where relatively useless if they were not linked to the offeror's bid. Encompassing the actual rates in the model will help make the identified savings defendable. An analysis at the RCC level would also be able to validate the amount of excess capacity for each RCC. As noted earlier, an understanding of the amount of excess capacity is necessary to ensure savings are applied correctly. Finally, the model needs to address the fact that there is theoretical limit to the amount of savings that can be realized.

**Research Objective 4**

*Identify factors of the "ideal" method of estimating overhead savings*

All of the experts suggested the best way to estimate overhead savings during source selections was to conduct the analysis at the lowest level possible. By conducting the analysis at the shop level, analysts would be able to determine which RCC were impacted by the new workload. This level of analysis would also provide insight to the excess capacity for each of the RCCs, and the validity of the estimates would be greatly enhanced by conducting such a low level analysis. In addition to the data analysis at the shop level, source selection members would interview the shop leaders for their expert opinion regarding the impact of the new workload. If the expert opinion coincided with

the data analysis, then source selection members would have a better assurance that the estimate was as accurate as possible.

Two experts stated that the ideal situation would be to establish cost-trade curves for each of the RCCs involved in the workload. These curves would provide an excellent source for determining the amount of excess capacity and the applicable range for the present costs. They both noted that an Activity Based Costing system would be necessary to identify costs in such a precise manner.

**Summary**

This chapter presented the results of the interviews conducted for this research. The interviews revealed that the experts felt the Overhead Rate Impact model was an inadequate method of estimating overhead savings. They disagreed with the model's assumption that one overhead rate can be used to estimate overhead for an entire facility. They also questioned the validity of the inputs provided for the model. If there is no assurance that these inputs are reasonably accurate, then the output of the model is unreliable. The experts also noted that the costs and rates associated with the model should be linked directly to the offeror's bid. If they are not, then the accuracy of these inputs becomes more questionable. Finally, the model does not address the fact that overhead savings are achieved in a "step-order" fashion. The assumption that existing rates are relevant over an unlimited range is inaccurate. Overhead savings may be achieved only up to the point where the workload exceeds the facilities max capacity. At this point, more fixed costs would have to be incurred to handle the workload. The next chapter will provide conclusions and recommendations based on these results and the analysis of these results.

## V. Conclusions and Recommendations

### Introduction

This chapter presents the recommendations and conclusions of this research based on the interview results presented in the previous chapter. The goal of this chapter is to draw a conclusion regarding the accuracy and effectiveness of the ORI model and to make recommendations for how to conduct overhead savings analysis in future source selections.

### Research Objective 1

*Identify the strengths of the Overhead Rate Impact (ORI) model*

The results indicated that there were very few strengths of the ORI model. The strength most frequently noted by the experts was that the model could provide an estimate very quickly. Since source selection teams are often operating under a time constraint, the estimate provided by the ORI model is better than none at all.

### Research Objective 2

*Identify the weaknesses of the Overhead Rate Impact (ORI) model*

The interviews revealed several weaknesses of the ORI model. The most widely noted weakness was that the average overhead rate assumed by the ORI model was inaccurate. The existing overhead rates where calculated using base-wide costs and hours. The analysis in the previous chapter showed how this technique distorted the actual overhead rates of different programs. It credited programs with savings when there where no shared resources with that program and the C-5, and it did not give enough credit to programs that would share resources with the C-5.

Another major weakness of the model was the validity surrounding the variability factor inputs of the model. There was no audit trail provided or available that the source selection team could use to assure the accuracy of these factors. Without the ability to validate these factors, the output of the model is immediately questionable.

The model assumption regarding the linearity of costs was another weaknesses revealed through the data collection process. Clearly, the overhead rates are only reasonable for an established workload range based on the amount of excess capacity for each RCC. Once the workload exceeds the capacity for an RCC, the overhead rates are no longer reliable because additional fixed costs must be incurred.

**Research Objective 3**

*Identify areas were the Overhead Rate Impact (ORI) model could be improved*

The recommended improvements to the ORI model are tied closely to the experts' opinions regarding the weaknesses of the model. The results show that the model could be vastly improved by ensuring the overhead rates in the model are calculated at the lowest level possible. This will ensure only those shops that will share resources with the new workload will receive credit for overhead savings. An analysis of the excess capacity at the shop level will further improve the model by establishing the applicable range for the overhead rates and the savings associated with the new workload. The percent variability factor is a crucial input into the ORI model, and the model's output would be vastly improved if analysts had greater confidence in how these factors are calculated.

**Research Objective 4**

Based on the results of this research, an analysis of overhead savings during future source selections should include each of the following:

1) Overhead rates should be calculated at the lowest level possible

2) Conduct analysis of the excess capacity for each shop impacted by the workload

3) Conduct a regression analysis at the shop level to provide an audit trail to substantiate how past savings have been achieved

4) Ensure the rates evaluated for overhead savings match the overhead rates in the offeror's proposal

5) Evaluate the applicable range for existing and future overhead rates

6) Recognize the theoretical maximum for achievable overhead savings

7) Validate the variability factors of workload at the lowest levels

**Barriers to Implementing this Method**

While the experts identified the ideal manner in which to estimate overhead savings, there are some barriers to implementing their suggestions. The first and most significant is the time constraint that most source selection teams face. Analyzing each individual show would take a great deal of time and manpower, and often times the source selection teams do not have the resources to commit to such an in-depth analysis. Access to the data is another potential barrier to this method. If the offeror is public, then the information may not be in an appropriate form for the source selection team to conduct a proper analysis. If a private offeror proposes overhead savings, then the offeror may be unwilling to provide the team with the information.

## Limitations of this Research

The first limitation to this research is the fact that the conclusions are drawn off of a relatively small sample size. Given the fact that this research was a case study of the specific model used during this source selection, the entire population of potential interviewees was limited to individuals who worked with the model during the C-5 source selection. As identified earlier, other potential interviewees where excluded from the population because their experience did not deal with the model for this specific case. The opinions of the experts who have used the ORI model were the exact information this research was attempting to extract. Since these experts comprised the population of subjects with the knowledge and experience to form opinions regarding the ORI model, it is reasonable to conclude that their opinions are reflective of those others might draw regarding the ORI model's usage in this case. Although members from the private offeror could have provided insight for the methodology used during this source selection, access and time constraints prevented their inclusion into the population of experts.

Because this research was qualitative in nature and employed an interview as the primary data collection methodology, the conclusions are subject to individual bias and interpretation. Additionally, the experts' experiences occurred four years ago, so there is the possibility that their recollection of the methodology was not complete. However, these facts do not detract from the conclusions drawn from these interviews because the bias and interpretation help comprise each individual's opinion. Regardless of how the subjects' opinions regarding the applicability or accuracy of the model where formed,

this research specifically sought to extract those opinions. As such, this is not believed to be a threat to this research's validity.

**Recommendations for Further Research**

This research is believed to be the first to investigate the methodologies used to evaluate overhead savings during source selections. As mentioned in chapter 2, there have been several source selection since the C-5 competition to evaluate overhead saving during the selection process. A review of each of the methodologies used during these source selections would help to validate the accuracy of the conclusions drawn from this research.

Additional research efforts could be undertaken to determine the actual savings achieved by the programs. An analysis of the current overhead rates for the C-5 program, or others programs where credit for overhead savings was provided during the source selection, would be useful to determine the actual savings being captured by the government.

Additional research of this specific model could also be conducted by widening the scope of experts. Further research could include analysts from the depots and analysts from the GAO. Though they could not provide insight into this specific source selection, they could provide their opinions of the model and how it should be used to estimate overhead savings.

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## REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 074-0188*



**1. REPORT DATE** *(DD-MM-YYYY)*
20-03-2001

**2. REPORT TYPE**
Master's Thesis

**3. DATES COVERED** *(From – To)*
Aug 1999 – Mar 2001

**4. TITLE AND SUBTITLE**

A CASE STUDY ANALYSIS OF THE OVERHEAD RATE IMPACT MODEL USED DURING THE C-5 MAINTENANCE SOURCE SELECTION

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**

William N. Ward, Captain, USAF

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)**

Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 P Street, Building 640
WPAFB OH 45433-7765

**8. PERFORMING ORGANIZATION REPORT NUMBER**

AFIT/GAQ/ENV/01M-16

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

N/A

**10. SPONSOR/MONITOR'S ACRONYM(S)**

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

**12. DISTRIBUTION/AVAILABILITY STATEMENT**

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

The purpose of this research was to analyze the effectiveness of the Overhead Rate Impact Model. This model was used during the C-5 Maintenance source selection to estimate the amount of overhead savings the contract award would generate. Specifically, this thesis sought to answer four research objectives addressing the strengths of the ORI model, the weaknesses of the ORI model, how the ORI model could be improved, and the ideal manner in which overhead savings should be evaluated. The research questions were answered through a literature review and the use of interviews. The literature review focused on best value source selections and how overhead savings plays a part in best value acquisitions. Six experts, each a member of the cost IPT on the C-5 source selection team, provided their opinion of the ORI model based on their experience from the source selection. The research identified several weaknesses with the ORI model. It also identifies key areas were the model should be improved.

The culmination of this effort was the recommendations of the ideal manner in which to evaluate overhead savings during future source selections. Recommendations on how to implement this technique are discussed.

**15. SUBJECT TERMS**

Overhead, Overhead Savings, Source Selection, Case Study, Best Value

| 16. SECURITY CLASSIFICATION OF: a. REPORT | b. ABSTRACT | c. THIS PAGE | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| U | U | U | UU | 60 | Lt Col William Stockman, ENV |
| | | | | | **19b. TELEPHONE NUMBER** *(Include area code)* (937) 255-3636, ext 4796 |